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MAIN CURRENTS

IN MODERN THOUGHT

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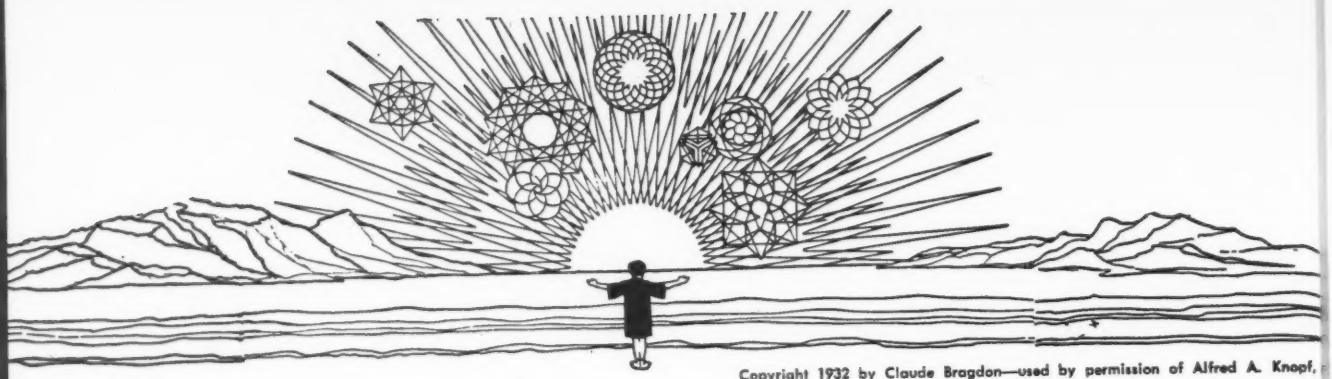

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MAIN CURRENTS

IN MODERN THOUGHT

A cooperative journal to promote the free association of those working toward the integration of all knowledge through the study of the whole of things, Nature, Man, and Society, assuming the universe to be one, dependable, intelligible, harmonious.

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The cover photograph; from Sir Hubert Wilkins, shows Fort Lockroy on the western side of Wiencke Island, Antarctica.

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DISPLACEMENT OF EARTH'S CRUST

Charles H. Hapgood

Keene Teachers College

An Integrated Theory of Earth's History Which May Shed New Light on Some Basic Problems

Ed. Note: The following article embodies the main argument of a theory which has been recently developed by Charles H. Hapgood and James H. Campbell concerning displacement of the earth's crust. The subject is documented and explained fully in a book by Mr. Hapgood entitled *Earth's Shifting Crust,* which will be published early in 1958 by Pantheon Press, New York, and Victor Gollancz, London.

Mr. Hapgood states that research into this problem was initiated in 1949, when he was teaching at Springfield College. After he was joined in the inquiry by Mr. Campbell, their theory was submitted to Albert Einstein, who proved most sympathetic and helpful. Later, they had assistance and advice upon various aspects of the problem from many distinguished specialists in the earth sciences.

OF all the questions that have been debated in the sciences of the earth, perhaps the most fundamental and the most involved is that of the stability of the poles. Despite every effort to establish the view that the poles have shifted during the history of the earth, or to prove that they have not, the controversy is just as lively today as ever. The new evidence bearing on this question now strongly favors argument for polar shift.

When the term polar shift is used, it may have several meanings. It may mean a change with reference to the stars of the position of the earth's axis, whose northern end points to the Pole Star, and southern end to the Southern Cross. Obviously, any change in the position of this axis would be very important, but this kind of polar shift has seldom been suggested, for no force capable of shifting the axis has ever been imagined, other than possibly a major interplanetary collision, which may have occurred in the history of the earth, but certainly not often.

A second cause of the shifting of the poles with reference to points on the earth's surface would be a change in the position of the whole planet on its axis, without change of the position of the axis. The principal obstacle to such a shift lies in the existence of the earth's equatorial bulge, which acts like the stabilizing rim of a gyroscope. The early writers on this question, such as LaPlace, Maxwell, Schiaparelli, and George H. Darwin, all recognized that a shifting of the planet on its axis to any great extent would require a force sufficient to overcome the stabilizing effect of the bulge. As they were unable to see what could give rise to such a force, it is small wonder that they dismissed the idea as utterly impossible.

This, however, left the evidence—such as fossil corals from the Arctic Ocean, coal beds and fossil waterlilies from Spitzbergen, and many other evidences of warm climates in the vicinity of both the poles—unaccounted for. Geologists were fertile in advancing theories to account for warm climates in the polar zones at the required times, but these theories were never substantially proven, nor did they explain more than a small part of the facts. Late in the 19th Century, the discontent of the biologists and paleontologists, who were constantly finding fossil fauna and flora in the wrong places, finally boiled over, and resulted in the formulation of a number of new theories for polar change, all of which were discredited, with one exception.

The exception was the theory of Alfred von Wegener, a good scientist though not a geologist. He found quantities of evidence that could not, in his opinion, be reconciled with the present position of the poles. Inasmuch as the doctrine of polar permanence forbade any idea that the earth had shifted on its axis, Wegener suggested that the continents had moved. He imagined that the continents, composed of light, granitic, and sedimentary rocks, had once formed a single land mass, but that this had split and the parts had been set in motion, drifting over a substratum which was plastic and viscous, rather than rigid and strong. From fossil evidence, he believed he could reconstruct the actual paths of the continents over long periods of time. He suggested that during the last ice age in the northern hemisphere Europe and America had lain close together near the pole, but that since then they had drifted apart.

Although Wegener's theory had great appeal, it also had a number of weaknesses. One of these was that the evidence from different areas, for the same geological period, would not produce agreement as to where the poles were located at a given time. Wegener recognized the seriousness of this difficulty, which, basic as it was, was by no means the worst

objection to his theory. As knowledge of the structure of the earth's crust was extended, it was found that the rock under the oceans, which Wegener had thought to be plastic enough for the continents to drift over it, is in fact very rigid. It is therefore impossible for the continents to drift; the crust must move altogether or not at all. As Dr. Harold Jeffreys, the noted geophysicist, said, ". . . There is therefore not the slightest reason to believe that bodily displacements of continents through the lithosphere (crust) are possible."

Another objection to the Wegener theory is as regards its assumption that the sea bottoms are smooth plains, across which the continents can drift. Oceanographic work of recent years has shown that there are mountain ranges on the bottoms of all the oceans, some comparable in size to the greatest on land. Also the Wegener theory involved the corollary that, as the continents had drifted slowly across the smooth ocean floors, these floors had accumulated sediment to great thickness. Recent exploration, however, has discovered that this thick layer of sediment is nonexistent, being in some places only a few feet or a few inches deep.

Another startling contradiction to the Wegener theory is presented by recent data, obtained through new techniques of radiocarbon dating, which show that the last ice age ended only ten thousand years ago. In Wegener's time geologists believed that the ice age ended at least thirty thousand years ago. Since Wegener supposed that Europe and North America had been located close together and not far from the pole during the ice age, the new data has the effect of requiring an incredible rate of continental drift—about fifteen hundred feet a year! Furthermore, movement at something like this rate must still be going on, for the momentum of a continent in motion would be tremendous.

In recent years, new evidence of changes in the geographical locations of the poles, resulting from studies of terrestrial magnetism, has been explained by some geologists in terms of continental drift, but much of this new evidence cannot be reconciled with the Wegener theory. To cap it all, Gutenberg has shown that the various forces which Wegener depended upon to move the continents are either non-existent or insufficient, while another geophysicist, Lambert, has stated that they amount to only one millionth of what would be required.

It is interesting to note that despite the quite overwhelming character of these objections, attempts are still made to rehabilitate or rescue the Wegener theory. A contemporary Soviet plant geographer, while recognizing the objections, yet remarked, ". . . it, nevertheless, constitutes the only plausible working hypothesis upon which the historical plant geographer may base his conclusions." And as recently as 1950 the British Association for the Advancement of Science divided about equally, by vote, for and against the Wegener theory.

This continuing interest is eloquent confirmation of the insistent pressure of the evidence in favor of polar shift. It seems clear that the only reason for continuing reluctance to accept polar shifts is the absence of an acceptable mechanism to account for them. The failure of successive proposals to explain polar change has caused scientists to reject the implications of the field evidence, and to fail to evaluate it on its own merits. These failures have reinforced the reigning doctrine of the fixity of the poles, with two consequences.

In the first place, the evidence amassed by those who had been led to attack the doctrine was quietly put aside. Second, theories have been invented to explain those facts that did not fit and could not be ignored. One such theory was that climates were once virtually uniform from pole to pole; that there were mild, moist conditions which enabled waterlilies and magnolias to bloom in the long night under the Pole Star. No way to account either for the virtual absence of climatic zones or for the ability of these plants to grow without sunlight was ever supported by persuasive evidence, yet the theory was and is still accepted by a considerable section of the scientific world.

These various contradictions are nothing but the reflection of the impasse between the steadily accumulating evidence and the entrenched doctrine of the fixity of the poles. The necessity of reconciling the growing data in a number of fields with an erroneous assumption has produced a multiplicity of futile theories, a veritable cloud castle of conjecture, without substance.

New Proposals for Polar Shift

SINCE truth cannot be suppressed forever, it was inevitable that accumulating facts should eventually bring the polar issue again into the foreground. Different hypotheses which might make the idea of crust displacement and polar shift more acceptable to the scientific world than the Wegener theory have been advanced by Gold, Blanchard, Ting Ying H. Ma, Bain, Pauly, Kelly and Dachille, among others.

Needless to say, none of these concepts has been brought forward without a good deal of evidence. Since there is no space in this article to consider it all, I will confine myself to certain especially significant features.

One of the important new pieces of evidence concerns the dates of glaciation in the northern and southern hemispheres. As a result of new methods of radiocarbon and ionium testing, used extensively since 1950, it has been proven that the ice cap in Antarctica, thought previously to be millions of years old, is, at least in large part, of very recent growth. Tests of cores taken by Hough from the Ross Sea indicate not only that the Antarctic ice cap is young, but that there were several previous ice caps in Antarctica in the last million years, separated by periods during which the sea was ice free, except for a few bergs. It appears from this discovery that the forma-

tion of the most recent Antarctic ice cap coincided with the melting of the great North American glacier, whose final phase has now been placed at only 10,000 years ago.

What kind of cause could glaciate one continent and deglaciate the other? It seems quite clear that only a shift of the crust of the earth, such as to move America away from one polar zone, and Antarctica toward the other one, can adequately account for the facts, for none of the great glaciations of the past is explained by the ice age theories hitherto advanced. The only ice age that is adequately explained is the present ice age in Antarctica. This exists, quite obviously, because Antarctica is at the pole, and for no other reason. No variation of the sun's heat, no galactic dust, no volcanism, no subcrustal currents, and no arrangements of land elevations or sea currents account for the fact. We may conclude that the best theory to account for an ice age is that the area concerned was at a pole, and we thus account for the Indian and African ice sheets, even though the areas once occupied by them are now in the tropics. It is evident that a displacement of the earth's crust could initiate an ice age by moving a certain region into a polar zone, while a later displacement could end the ice age by moving the same area away from the polar zone.

There is a large amount of additional evidence for displacements of the earth's crust provided by mountain chains, earth fractures, volcanic zones, and the history of continents and ocean basins, none of which can be considered here, although it is presented in detail in my forthcoming book.

Two principles must be understood in connection with the theory of crust displacement: first, the principle of centrifugal effect, and second, the principle of isostacy. The latter is defined by Funk and Wagnalls as follows: "Theoretical condition of equilibrium which the earth's surface tends to assume under the action of terrestrial gravitation as affected by the transference of material from regions of denudation to those of deposition, and by difference of density of various portions of the earth's mass near the surface."

The globe we live on is round because of the force of gravitation, but it is not a perfect sphere because it is rotating rapidly, and this produces a centrifugal effect that tends to throw the materials of which it is made outwards at right angles to the earth's axis, and against the force of gravity. This produces a bulge around the equator and a flattening at the poles. The earth modifies its shape until the two forces are in balance.

Of course there is always a considerable amount of shifting of materials on the face of the earth, and these changes constantly upset the balance and require readjustments. As the crust of the earth is very thin, compared with the whole diameter of the globe, it is correspondingly weak, and usually gives way if much material is accumulated at one spot. The layer under the crust is thought to be plastic, viscous or semi-liquid, permitting the crust to give way by flowing out from under it. This process is called "isostatic adjustment."

According to the principle of isostacy, it has been widely assumed that an ice cap such as the one in Antarctica should be in good isostatic equilibrium. Of course, if this were true, the centrifugal effect of the ice cap would be balanced at every point by the force of gravity, and there would be no effect left over to tend to shove the crust over the plastic layer below. Thus, our theory depends upon our ability to show that isostacy has not operated effectively in Antarctica. The question becomes one of estimating the difference between the rate of growth of the ice sheet, the rate of yield of the crust, and the rate of flow of the plastic layer under the crust. Mr. Campbell's calculation of the centrifugal effect of the ice cap, and of the resulting bursting stress on the crust, is based on the assumption that the whole mass of the ice cap is uncompensated. It is intended only as an approximation, and must be modified as soon as direct information as to the degree of the isostatic adjustment of the ice cap is available.

There are a number of considerations which indicate that there is, at the present time, a massive departure from isostatic equilibrium in Antarctica. As already mentioned, one of the most astonishing things revealed by the new techniques of radioelement dating is the rapidity of the growth both of the present ice sheet in Antarctica and of the last great ice cap in North America. Even before the new knowledge was available, however, various authorities had agreed that there must be a considerable lag between the growth of an ice sheet and the adjustment of the crust to it by sub-crustal flow of the plastic rock out from under the glaciated tract. Because of this lag, it may reasonably be presumed that any ice cap, at the height of its rapid accumulation, must be largely uncompensated.

But even if, during the rapid growth of the present Antarctic ice cap, a degree of isostatic adjustment has taken place, this does not end the matter. For where can the plastic rock displaced by the ice cap flow? Wherever it goes, it must create a distortion, a surplus of matter, which will have a centrifugal effect. From the standpoint of our theory, it makes no difference whether the excess mass which creates the centrifugal effect is constituted of ice, or whether it is in part constituted of rock. It may be concluded, therefore, that the isostatic process itself is ineffective in counteracting the centrifugal effects of great ice caps. We suppose, then, first that the rate at which isostacy may work is too slow to keep up with the deposition of the ice; and second, that insofar as it does work it will not eliminate the centrifugal effect of the uncompensated mass, but will merely substitute rock for ice.

The Antarctic Ice Cap

OUR theory requires, of course, that a polar ice cap should continue to grow, though perhaps

not steadily, until it is big enough to move the crust. Therefore, certain current ideas about the Antarctic ice cap are of importance.

There is a mistaken assumption that the Antarctic ice cap, like some ice fields in the Northern Hemisphere, is in recession, and was once greater than it is now. Because of the fact that most of the northern ice fields, with some significant exceptions, are melting, and because recent weather research has made it plain that alternating climatic phases of slightly colder or warmer temperatures have been the rule for some thousands of years, it has been assumed that the Antarctic ice cap was greater in the past than it is now.

We now know, however, that this ice cap is of very recent growth, and that it was preceded in a comparatively short period by several previous ice caps, and we can assume that the centers of the different ice sheets were in different places, so that the distribution of the ice would be different from now, even if the total amount were about the same. Once it is fully recognized that the geological evidence of Antarctic ice recession must be reinterpreted in the face of evidence of several successive ice ages, we shall be in a better position to evaluate other evidence, such as the present very rapid accumulation of snow in Antarctica, the lack of any considerable melting, and radioelement evidence that there has indeed been an enormous expansion of the ice cap there in recent millenia. To this may be added a fascinating recent discovery, by Arlington H. Mallery, that maps based on information 2500 years old show the coastal lines which now lie under the ice cap, but which must have been surveyed by the authors of the maps. (These are reproduced in my forthcoming book, and form on extension of a book by Mallery entitled *Lost America,* which appeared in 1951.)

The North American Polar Ice Cap

SEVERAL independent lines of evidence, each individually extremely impressive, unite to suggest that the Hudson Bay region lay at the North Pole during the so-called "Wisconsin" glaciation.

The first line of evidence is based on the shape, and on the peculiar geographical position of the last North American ice cap. Kelly and Dachille point out that the area occupied by the ice was similar both in shape and in size to the present Arctic Circle. Many geologists have remarked on the unnatural location of the ice cap. It occupied the northeastern rather than the northern half of the continent, leaving some of the northern islands in the Arctic Ocean and Northern Greenland unglaciated. Alaska and the Yukon had mountain glaciers, but no continuous ice sheet. Then, the ice is known to have been thicker and to have extended farther south on the low central plains of the Mississippi Valley than it did on the high mountain areas in the same latitudes farther west. But according to accepted ideas about glaciation, if the ice age was the result of a general lowering of world temperatures, the ice should have formed first in the mountain areas, and should have extended farther south on them than in the low plains. The assumption that the Hudson Bay region then lay at the pole would make these facts easy to explain, for in this case the western highlands would lie to the south of the plains region, and thicker ice could be expected on the plains lying nearer the pole.

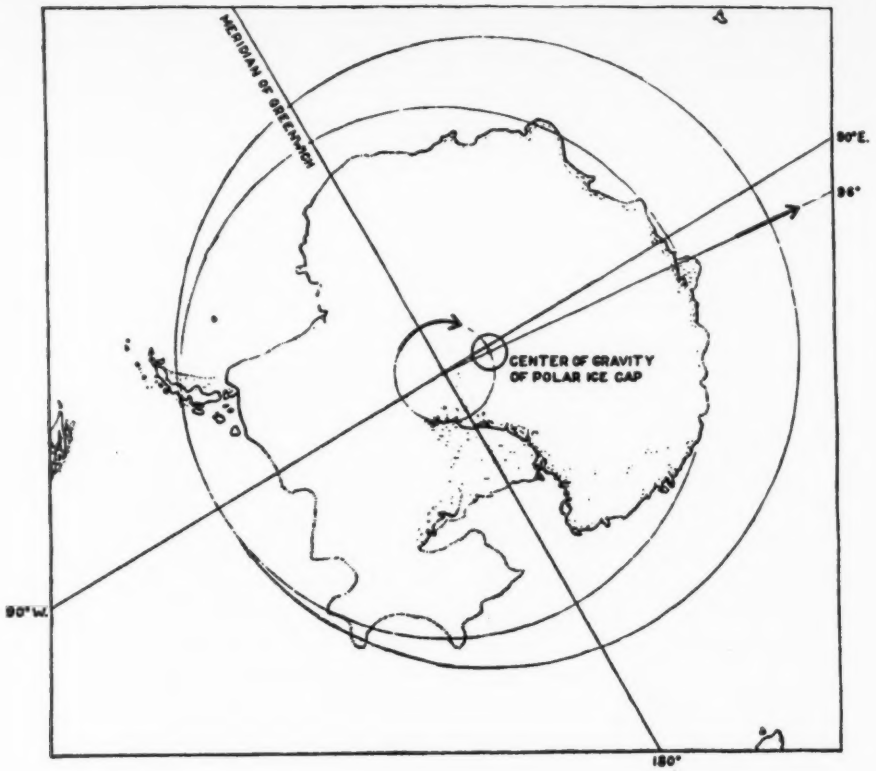
A second line of evidence for the position of North America at the pole consists of the new data regarding recent climatic change in Antarctica, already mentioned. A shift of the crust that would move North America southward about 2,000 miles would also necessarily move Antarctica that much nearer the South Pole. Therefore, a displacement of the crust accounts both for the deglaciation of North America and for the expansion of the ice cap in Antarctica, and accounts for the two events being simultaneous. No other hypothesis so far suggested, such as that of a simultaneous world-wide reduction in temperature, can account for climatic revolutions in opposite directions on the two continents. In a personal interview, I once asked Einstein if he could see any logical alternative to crust displacement as the explanation of these facts. He replied that he was persuaded of the soundness of the method of crust radioelement dating developed by Professor Urry, and that he saw no other explanation.

Displacement Caused by the Ice Itself

IT may be argued that convincing evidence of a displacement of the crust by no means requires the further conclusion that the movement at the end of the ice age was the result of the centrifugal effects of the North American ice cap. A dozen other possibilities may be thought to exist. Why, then, jump to the conclusion that the event was related causally to the ice cap?

There have been several suggestions to account for shifts of the crust by other agencies, but all of them involve very long periods of time, of the order of a million years. They have a common inability to explain the velocity of events revealed by the new methods of radioelement dating. They are also vague as regards the mechanism of displacement. They can be grounded neither upon detailed observations, nor upon mathematical calculations. The mechanism developed by Campbell, on the other hand, is quite definite and precise, although it, too, necessarily must involve assumptions. Of special importance is the fact that Campbell's mechanism is capable of being checked against geological observations in some detail.

It is significant that the Wisconsin ice sheet was assymetrical in its distribution about the center from which it spread. If we assume that this center coincided at that time with the pole, then this assymetrical distribution must have resulted in a centrifugal effect. Furthermore, the great bulk of the ice lay to the south of the ice center, so the direction of the



THE CENTRIFUGAL EFFECT OF THE ANTARCTIC ICE CAP

To realize the centrifugal effect of the Antarctic ice cap, imagine this map to be rotating rapidly with the rotation of the earth. It is easy to see what an enormous sidewise heave results from the eccentricity of the geographical center of the ice cap. Note that the direction of the thrust of the ice cap is along the meridian of 96° East Longitude, in the direction of the arrow.

resulting centrifugal thrust would have been southward, and the effect would have been to shift the Hudson Bay region due south, from the pole toward its present latitude. This is indeed in remarkable agreement with the theory.

It may be asked, why should the smaller North American ice cap have started a slide of the earth's crust, when this larger one in Antarctica hasn't? The answer appears to lie in the different degrees of eccentricity, or assymetry, of the two ice caps. In Antarctica, the pole is fairly near the center of the continent, so that the real assymetry of the ice cap is not at first glance apparent. In North America the presumed pole in Hudson Bay, or perhaps western Quebec, was on the eastern side of the continent, quite near the sea, putting its center of gravity farther from the pole, so that the centrifugal effect would have been greater in proportion to the quantity of ice. An additional observation worth making, perhaps, is that if this vast ice sheet had developed so rapidly at the present latitude of Hudson Bay, the centrifugal effect would have been colossal.

We can therefore conclude that, on the whole, the North American ice cap is a good candidate for the position of prime mover in the last displacement of the crust.

The Electric Earth

IN the space remaining, I should like to refer briefly to some new data derived from studies of terrestrial magnetism, which constitute evidence for crust displacement so impressive that it has brought about a reversal of opinion among many geologists on the question of the permanence of the poles. Dr. J. W. Graham has recently remarked, ". . . in the light of our more recent knowledge of the earth and its properties . . . the conclusion is reached that, whereas polar wandering was formerly considered impossible, it now seems to some, at least, inevitable."

This conclusion is based upon recent studies of the polarizing effect of the earth's electrical or magnetic field on minute rock particles. The force of terrestrial magnetism acts on iron-containing minerals, both in sedimentary and igneous rocks. It was at first believed that the directions of polarization adopted by rock particles at the time of the original consolidation of

the rocks would be permanently retained, and would indicate the direction of the earth's magnetic field at the time of consolidation. However, it became apparent that several factors could change the original direction of magnetization. In addition to changes in the directions of polarization, which scientists interpreted as evidence of shifts of the earth's crust, there were found many instances of total and apparently quite sudden reversals of the magnetic directions through 180°. Recent research supports the view that there were probably local forces at work within the crust that were capable of bringing about local reversals of magnetization.

In 1949 specialists at the Carnegie Institution of Washington discovered in a number of deposits of the Silurian period (approximately 300,000,000 years ago), stretching from Maine to Maryland, rocks that were not lined up with the present poles. Because of the possibility, founded on the most recent research, that these rocks may have been repolarized at some time subsequent to the deposition of the sediments, it cannot be taken for granted that the magnetic direction of the particles in these Silurian rocks represent the direction of the earth's field in Silurian time. The magnetizations may date to some time after deposition.

Studies of rock magnetism published in 1954 by Clegg, Almond and Stubbs, induced them to conclude that ". . . the most likely explanation of the observed horizontal direction of the magnetization of the sediments studied is that the whole land mass which now constitutes England has rotated clockwise through 34° relative to the earth's geographical axis. This movement must have occurred since the rocks acquired their magnetization, which was probably at or soon after the time of deposition (150 to 200 million years in the case of the Triassic sediments) but conceivably much later."

Other studies of fossil magnetism by Runcorn have led him to accept the conclusion that movements of the crust, or of the outer layers of the earth over the core, have often occurred, although the mechanism remains nebulous. In a recent lecture at Columbia University, Runcorn commented on the dogma of the permanence of the poles, which has long served to impede research in the field of fossil magnetism. Only in the last two years has the accumulating evidence succeeded in breaching the wall of prejudice. It now appears to Runcorn, and many others, that there is no choice but to accept either continental drift (the formidable objections to which have already been cited) or crust displacement.

Summary

THERE is a large and highly detailed mass of material dealing with a broad range of complex subjects—geology, geophysics, paleontology, biology, volcanology, terrestrial magnetism, etc. — which I have sought to relate to a single, essentially simple hypothesis: polar shift brought about by crust displacement. As a consequence of the accumulation of all this data, many writers at the present time are discussing polar shift, but none of them has as yet suggested an acceptable mechanism. The assumption of displacements of the earth's crust serves to solve a wide range of problems such as ice ages, warm polar climates, mountain-building, changes in the elevations of land areas and in the topography of the ocean floors, perplexities created by fossil magnetism, and conflicts in isostatic theory, and it permits the construction of a chronology of polar shifts. The theory is able to explain not only the general succession of climatic changes in various parts of the world in the late Pleistocene, but also the detailed history of the last North American ice cap, the effects of volcanism, and the resulting widespread extinctions of species at the end of the Pleistocene and probably in earlier geological periods. By providing a reasonable basis for the assumptions of rapid climatic change and rapid topographical change, the theory provides solutions for many problems in the evolution and distribution of species.

The theory of displacement developed by Campbell and myself depends upon only two assumptions: first, that a continental ice cap is largely or entirely uncompensated isostatically, and second, that at some point below the crust a weak layer exists that will permit the displacement of the crust over it. The first assumption is capable of verification; there is no present prospect of direct verification of the second. However, the body of geological evidence provides strong indirect support for both assumptions.

As to the mechanics of crust displacements, Campbell has provided the necessary constructions. To some, the simplicity of his thought may be unnerving, but I feel assured that in the end this simplicity itself will be its own justification. For it appears that no recondite principle can vitiate it. Who can argue with formulae so simple that a high school student can, and usually does, master them? Any mathematician can show up the errors, if there are any. It was the simplicity of the theory that first aroused the interest of Einstein, in whose philosophy of science simplicity was a prime desideratum.

I have to admit that the full development of the implications of crust displacements has carried me much farther than I originally expected. When I resurvey the structure that has now been erected on the simple basic theory, I feel exactly as did Sir James Frazer, at the end of his protracted labors: (*The Magic Art,* Vol. I, vi, 1885).

"Now that the theory, which necessarily presented itself to me at first in outline, has been worked out in detail, I cannot but feel that in some places I may have pushed it too far. If this should prove to have been the case, I will readily acknowledge and retract my error as soon as it is brought home to me. Meanwhile, my essay may serve its purpose as a first attempt to solve a difficult problem, and to bring a variety of scattered facts into some sort of order and system."

THE THIRD REVOLUTION AND THE FIFTH ESTATE

Boris B. Bogoslavsky

Co-Director, Cherry Lawn School

The Destiny of the Egghead

AT the end of the XVIII Century in France, extraordinary and violent events were taking place that profoundly influenced the future of western civilization. Now we refer to them as the French Revolution, *the* Revolution, and know that the essence of that revolution was the coming to power and prominence of the bourgeoisie, the Third Estate.

If, a few decades before the revolution, some clairvoyant had prophesied that the humble members of the Third Estate, the sansculottes, would defy, defeat and destroy the power of the two other estates, nobody would have believed him. If he had insisted that in a century and a half the dynasties of Rothschilds, Rockefellers and Stinneses would rule over the rulers of great states, and that "Bozses" in Amsterdam, Paris and London as well as Wall Street in America would control the economic life of the world, he would have been taken for a lunatic. Yet all this is now a historical truism.

About the same time, another revolution was developing in England and in Western Europe, a revolution less violent and less spectacular, but perhaps even more important. This was the Industrial Revolution. Its social significance lies in the fact that it brought to power the fourth estate, Labor—workers who then had "nothing to lose but their chains."

Again, at that time nobody could have imagined that in less than two centuries in America the rank and file of the then "miserable proletarian rabble" (not to mention their top representatives!) would enjoy greater luxuries, in certain respects, than the kings and princes of the past, and that the Labor Party would be one of the two most powerful political parties in England, its leaders peered and knighted by the Crown. Equally fantastic would have been the prediction that in order to attain respectability political parties in Europe would decorate their names with the words "Labor" or "Socialism," and that even totalitarians of all hues would camouflage their reactionary nature by posing as champions of the workers. Yet all this is now common knowledge.

The two revolutions and their consequences are of more than academic interest to us. Not only have they formed the foundations of our civilization; they have great practical importance for our generation because we ourselves are living in the midst of the most extraordinary events. What we are witnessing now is indeed the Third or Intellectual Revolution, and the fifth estate it is ushering into prominence, power and glory is that of the brainworker, the intellectual, the egghead.

The impact of the third revolution will be more far-reaching than the consequences of the two previous upheavals put together.

Suggestions from the Past

TO derive the greatest possible benefit from the new era, and to find the safest path through it, we must well understand what is happening now. The best way to do so would be to analyze the main features of the two previous revolutions and get acquainted with their dynamics.

As mentioned above, one of the fundamental functions of a social revolution is to bring a new estate to power. In fact, a revolution *is* primarily the bringing to power of a new estate. The term "estate" is used here, of course, not in the limited sense of a social institution that existed in France under the old regime, but to signify the generalized concept of a social group performing almost exclusively a certain important function.

Let us have a look at the estates in this sense, as they are suggested by the French Revolution. They are the first estate, the clergy or specialists in practical religion; the second estate, the nobility, which is subdivided into the nobility of the sword (the military) and the nobility of the robe (the civil servants and legal functionaries); and finally the third estate, the bourgeoisie, capitalists.

Functions of the Estates

WHAT is the function of each estate? The first estate, the religionists, provided undifferentiated general leadership in all forms of personal and social behavior, particularly at the dawn of civilization. It provided a sense of unity, the feeling of "belonging," and supplied the social ties necessary to keep the community together, since no community can exist without a common orientation concerning the fundamental powers discernible in the environment and

the mysteries behind them, or without some rationale about social relationships and some pattern of teamwork for securing the necessities of life. Religious leadership in that sense is practically synonymous with a primitive community. Later on, giving different specific functions, step by step, to other estates, the religionist became a specialist in spiritual guidance.

As for the second estate, the function of the military is obvious. No community can exist without protection against outside enemies who would otherwise conquer and enslave it. With the growth of a community, the function of protecting the elementary rights of members of the community in everyday life becomes almost equally necessary. Thus the "nobility of the robe" performs the function of maintaining law and order.

Finally, the function of the third estate, the bourgeoisie, is to raise the general standard of living of the community by increasing production. This is accomplished by the accumulation of capital, or, in other words, of goods that are unconsumable and needed only as tools for producing more goods or tools, but not for the direct satisfaction of any human want. The paramount importance of this function is undeniable. Even the greatest opponents of capitalism, the Communists, apply most of their energy to the accumulation of capital.

Turning to the Industrial Revolution, we see that the function of the fourth estate is mass-production. No form of capital, no tool or machine could (until lately), produce anything without being complemented by man. The efforts needed to assist and direct machines are provided by the workers who make mass production possible.

Dynamics of Ascent to Power

THERE are several interesting aspects concerned in the process of ascent of estates to power, which is the essence of all revolutions.

To start, what are the circumstances that cause or favor the coming of an estate to prominence?

As far as the first estate is concerned, the question is really irrelevant. No community can exist without some kind of leadership of a father, patriarch, matriarch, elders, or chief, and at the beginning the leadership must be general and undifferentiated. Therefore, almost inevitably it must be religious and coexistent with the community.

The military also needs no special circumstances to bring it to power because, by definition, it *is* power. As soon as specialization of leadership starts, military men are recruited by natural selection from the strongest physically or the most skillful in the art of fighting.

The transfer of power from military to civilian authorities calls for a revolution. In a sense, the history of mankind is a continuous and yet unfinished revolution, leading from the unlimited power of warlords, caesars, emperors, monarchs and kings to the situation so well characterized by Clemenceau's declaration that war is too serious a business to be entrusted to generals. Perhaps the situation is more convincingly illustrated by the fact that in the United States the Commander-in-Chief, being the President, is given the post not because of his military exploits, but sometimes in spite of them!*

Looking for the factor which favors the revolutionary trend, we may discern one general tendency: the greater the security from attack by an external enemy, the more favorable the conditions for superiority of civil authority over the military. In general terms, paradoxically enough, the more advanced the performance of its function by a "previous" estate, the better is the chance for the next estate to come to the fore.

This fact is even more pronounced in the case of the bourgeois and industrial revolutions. Without an organized government and a guarantee of fundamental rights, particularly the right of property, both state and private, no accumulation of capital could be possible, and without sufficient capital, mass production and the appearance of the working class could not have taken place. To sum it up: a new estate is created when a new important social function appears on the horizon and previous development makes its performance possible.

Here it should be emphasized that while the appearance of a new estate is closely connected with the performance of a new social function, this does not mean that the particular function was never before performed in the community. From the moment the first hoe was made, or part of the grain was put aside as seed for the next crop, the accumulation of capital continued steadily, even if amateurishly, long before the First Revolution. A revolution only assigns the particular function to a certain social group as its specialty and near-monopoly.

Also, the fact that previous estates do the spade work for the next estate, open the gate for it and usher it into the limelight of history, does not mean that they welcome the newcomer or are friendly to it. The bloody course of the French Revolution is known to everyone. The working class in its ascent to power met with active opposition, not only from the capitalist, but also from the state machinery, the military caste, the feudal-minded nobility and the official church.

On the tactical aspect of revolutions an interesting question is: what are the means used by different estates in their struggle for predominance? Although all estates possess certain kinds of ammunition in common, each one uses as its most potent and decisive weapon the function that is its specialty or monopoly. Thus, the military acquires and maintains its power by force of arms; the nobility of the robe, by administrative and legislative measures, and by preventing citizens from sharing in government; the bourgeoisie, by controlling money, by financing

*Of course, the process is not a one-way street. Side by side with it we have many counter-revolutions. Napoleon and totalitarian militarism provide familiar reminders.

and bribing governments, and by securing the greater voting power to the moneyed groups of society; finally, labor, by exerting pressure on the mass production front, by using strikes as its major weapon, and by securing suffrage for the masses.

The last point of interest to be considered is the fact that after acquiring prominence each estate exercises a profound influence on the functions performed by the previous estates and on the estates themselves.

As an illustration let us take the military. At first it was self-sufficient and supreme. When civil authorities came to the fore it became a servant of the state which recruited soldiers and controlled the military organization. The era of the bourgeoisie made Talleyrand say that for war you need three things: money, money and more money. After the Industrial Revolution, technological potential and manpower became the major military factor, the army became the mass-army, conscription became universal, and destruction became total destruction. A similar effect was experienced by all the other estates.

The Present Situation

BEFORE we apply generalizations to our present situation, a word of caution would not be out of place. It would be a great mistake, when thinking of the social process in terms of revolutions and estates, no matter how helpful the concepts may be, to visualize the past as a parade of revolutions passing, one after another, before the reviewing stand of History. First of all, each revolution is a long and complicated process whose visible part, as in the proverbial iceberg, is much smaller than the rest. Each revolution starts with a dim period of haphazard experimentation with the function in question. Then comes a long stretch of gradual crystallization of the function and the quantitative growth of its estate. And only at the end, when the estate actually comes to power, does the highly noticeable, often striking climax appear.

Besides, even if they have a certain order in time, revolutions are more like waves having a different length and origin, but proceeding into the future together. The historic process may be likened to the sonorities produced by an orchestra which are a counterpoint of many voices, each of them reaching its climax at its own time.

The Intellectual Revolution

IN the light of the dynamics of revolutions outlined above, there is no doubt that a new revolution is taking place before our own eyes. This revolution is the Intellectual Revolution and its estate is that of the brainworkers.

This does not mean, of course, that in the past human intellect did not function importantly. To be a good general, judge, or banker, a certain amount of intelligence was necessary, and did help, but only as an additional factor which made a general or banker a *better* general or banker. He was still primarily a general or a banker. The intellect of the modern brainworker is his main professional qualification, on the other hand, and his intelligence is used in a professional, organized, scientific way.

Intellectuals (in this sense) are now a social group whose members are primarily brainworkers and only secondarily something else. Their function is, more exactly: a) solving problems, making discoveries concerning the nature of reality, and building systems explaining reality; b) communicating information; and c) proving that statements in question are correct—in other words, persuasion.

Accordingly, there are different categories of brainworkers. We may start with those who solve immediate and practical technical and technological problems: engineers and inventors. Thomas Edison was a brilliant specimen of this type. Usually this group is connected with the term Technological Revolution. Very close to this category are the specialists in problems connected with the human factor in technological processes: efficiency experts, human engineers and organizers of teamwork. They are usually connected with the term Managerial Revolution. Next come scientists, scholars, research people, "professors and eggheads" in popular parlance. Albert Einstein was a typical and popular representative of this group, which is often associated with the idea of Scientific Revolution. Very close to them are those who study scientific discipline and apply the results of their investigations to the solution of practical problems, such as physicians, lawyers, statisticians, agriculturists, etc. Finally—and they should not be forgotten —there are the performers of the functions of information and persuasion: writers, journalists, commentators in the press, on radio and television, teachers on all levels, public relations personnel, the advertising crowd, preachers, etc. All the above mentioned people professionally and systematically use their intellects and cannot function without possessing a relatively high level of intellectual ability. Therefore they qualify for membership in the fifth estate: brainworkers.

The Intellectual Revolution is now in its rather advanced stage, as even a cursory survey of its impact on the functions of the other estates shows.

As far as the military is concerned, atomic and hydrogen bombs as well as guided missiles are the dominating factor in the activities and further development of our Army and Navy. Obviously they are products of the cream of the cream of the "eggheads." The hunt for German specialists in the field after the Second World War has shown the dependence of modern armed forces on scientists.

On a recent television broadcast, an official representative of the Navy said that in high echelon units dealing with problems of guided missiles a man's authority depends more on his scientific qualifications than on his rank, and scientists are often more important than the high brass.

The importance of the Public Relations personnel

in the Armed Forces also indicates that the information and persuasion functions of brainworkers are needed there. The extent and intensity of these efforts can be seen from the latest best seller, *Don't Go Near the Water,* even discounting its sarcastic tone.

In the realm of the second estate, government and political activities, the influence of intellectuals is steadily growing. Every decade more and more research institutions and individual research specialists are incorporated into the machinery of government. At all meetings and conferences and in government missions a veritable army of specialists, experts, consultants, advisers, analysts and statisticians plays an increasingly important role. Perhaps the most organized and conscious efforts in that direction have been the Roosevelt "braintrust" and the present courting of the "intelligentsia" by the Soviets.

In the process of forming a government and securing popular support for it, brainworkers also play a more and more important part. In democracies like the United States, no sizeable political campaign, particularly Presidential, is possible without advisers of all sorts—ghost-writers, campaign managers, specialists in public relations and plain advertising professionals. Another recent satirical novel, *The Golden Kazoo,* registered the development of this trend. As for the totalitarian states, their very foundation has been propaganda, remarkably well organized, supported by unlimited funds, and performed by highly specialized brainworkers.

In the province of the third estate, the accumulation of capital, there have been, traditionally, two steps: making machines to produce goods, and making machines to produce more machines. To these the brainworkers' revolution has added a third step: automation, or producing machines to control machines. The new mechanisms expand the productive capacity of machines tremendously, make them less dependent on immediate human efforts, and thus allow for almost unlimited increase in the accumulation of capital and in production.

The other contribution of the brainworkers' revolution is the increase in the production of power necessary to put all these innumerable machines into operation. Instead of using the relatively small amounts of energy released by chemical processes from the traditional fuels such as coal and oil, we are approaching the era of exploitation of the practically inexhaustable stores of nuclear energy. Together with the technique of automation, nuclear energy will provide us, not with the mechanical slaves of the past, but with an unlimited multitude of mechanical genii who will obediently fulfill our wishes.

We should not forget another child of the third revolution, no matter how unruly, mischievous and selfish it may be: advertising, which exploits brainworkers in the field of communications and persuasion, and consumes million of dollars every year.

Finally, labor is being affected by the last revolution in three ways. First, atomic energy and automation will make it increasingly less indispensable for economic activities. What is really needed now for further progress is not so much manpower as brainpower. Secondly, under the impact of the growing reduction of working time, of greater leisure and higher standards of living, the "working masses" are becoming more and more the "consuming masses." Finally, manual workers are continually forced to change into mechanics of one kind or another—in other words, to specialize.

Brainworkers' Predicament

ALL this clearly shows the scope of the Intellectual Revolution and the dimensions of its impact on modern society, and yet in other respects the revolution is far from its concluding stage—the bringing of its estate, the brainworkers, to the prominence they deserve due to the importance of their function.

The situation is obviously unsatisfactory for the brainworkers themselves. They are underpaid and enjoy no appropriate social recognition. Increase in remuneration either passes them by or comes to them last. The term "egghead" tells the whole story of a very common attitude towards them. Fortunately, the problem is somewhat simplified by the peculiar ability of intellectuals to enjoy the very performance of their function, their less pronounced lust for the luxuries of life and the fact that they need recognition more than admiration.

The conditions, however, are even more injurious to society as a whole than to the brainworkers. Not being properly taken care of, they cannot contribute in full measure to the welfare of society.

The further progress of our civilization depends primarily on the proper use of our intellectual resources. The two most urgent problems mankind faces at present—achievement of genuine international cooperation and the implementation of safe universal disarmament—cannot be solved without a total mobilization of all available intelligence.

More specifically, our military and industrial might is imperiled by lack of research workers. The future of our children is jeopardized by the scarcity of competent teachers. Our national health is in danger because of the insufficiency of doctors. The vitality of our cultural life and international prestige are undermined by the low status of our intellectuals.

Neither the brainworkers themselves nor society at large can wait until the historical process, by its own impetus, solves all of our problems. It might be too late to save us from universal destruction. No revolution ever reached its natural conclusion without the vigorous efforts of the corresponding estate. What should the eggheads do to consolidate their position and acquire the social status they deserve? The problem is complicated, and calls for a separate analysis.

Note: Some practical suggestions will be incorporated in the second part of this article, to appear in a forthcoming issue.

THE MODERN PREDICAMENT*

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A Suggestion That Scientific Perspective Can Ease Our Cultural Lag

THE scientific, moral and spiritual predicament in which we live today holds some important lessons for us all. You will guess at once what I mean by this plight of ours, and your hearts may be sinking in fear that another lecture on the awful dangers of the atomic bomb will be inflicted upon you. But this is not my intention. It is true that our race has discovered means of destroying itself, and that, to achieve survival, statesmanship needs to reach a balanced attitude of mind and a new perspective of things. It is this necessary perspective that I want to discuss rather than the scientific facts, to which I shall refer only in passing.

In a recent commencement speech, the following argument was presented: scientists on all sides are scaring us with the terror of modern weapons, with their talk of impending disaster. But only a person unversed in history would take such talk seriously, for history shows that scientists have always been prophets of doom. When the cave man made the first slingshot, he doubtless proclaimed his ability to kill all men, and a similar boast must have been uttered by the anonymous inventors of bow and arrow, and of gunpowder. Such grandiloquence must not be taken seriously, for history exposes it to ridicule in retrospect. And so our present age, when viewed with historical detachment, will outgrow its self-glorification as well as its terror and its claim to uniqueness; a saner past will show it wrong.

Such reasoning, I fear, is utterly erroneous and the beguilement it offers presents an overriding danger.

Let us compare the amounts of energy released by various propelling agencies. The human hand is able to deliver an energy of approximately 50 foot pounds to a stone which is to be projected. A slingshot multiplies this energy by a factor 2; a bow and arrow increases the energy release of the slingshot by a factor 3; gunpowder adds another factor 4. The energy released by TNT is somewhat indefinite because the explosive mass is variable, but intrinsically, mass for mass, it introduces another factor of 2 or 3 over the efficiency of gunpowder. The output of a thermo-nuclear bomb is 10,000,000 times as great as that of a TNT device. Our factors are thus 2, 3, 4, then perhaps 5 for TNT; but the step to the thermo-nuclear bomb involves a factor of 10,000,000. When a scale factor of such magnitude appears, it is useless to speak of only quantitative differences. The new situation differs qualitatively from everything that has preceded.

This is one example which shows that the past fails utterly in providing adequate predictions for the future because of the evident uniqueness of our time. To say that wars must persist because there have always been wars, that world government is impossible because it has never succeeded, are instances of irresponsible uses of history for prediction in an age that defies most parallels.

There is a deeper meaning to this plight of ours, a meaning that reveals itself when the effect of science on our culture is analyzed.

EVERY great scientific discovery launches two movements, one technological, the other, cultural. The first is clear and open; it is the one which we normally associate with the advancement of science. I shall call it the Obvious Movement. It proceeds from discovery through engineering development, production of new goods and devices, advertising, sale, toward the establishment of greater comforts of life.

But there is another movement, the Obscure, which also springs into existence when a trenchant discovery in science is made. It proceeds from discovery through new theory, modification of what is called common sense, changes in our cosmological beliefs, in the theory of knowledge, the nature of the universe, and of man. Ethics, sociology and politics are ultimately infected by the germ that is born when a discovery in pure science occurs.

Through the Obvious movement, science alters the external milieu of our life; through the Obscure movement, it modifies the cultural atmosphere in which man lives. A survey of the history of human thought indicates, I believe, that crises are inevitable when the two movements, the Obvious and the Obscure, do not proceed at the same pace. This is doubtless one reason for the predicament in which we

*Colloquium address at the May 1957 meeting of the American Unitarian Association, in the First Church, Boston, Mass.

live; for our society has placed all of its resources behind the Obvious movement, while the Obscure movement is left to flounder along as best it can.

To document this claim is an easy matter. Two scientists, Galileo and Newton, founded the theory of mechanics, a tremendous scientific discovery which had its technological effects some hundred or two hundred years later. The Obscure philosophical movement required an approximately equal time for its completion. The philosophically significant ingredient of the Galileo-Newton theory lies in its claim that the laws of nature are precise, inevitable, and apodictic. This novel and unique feature required explanation, and received it finally in the philosophy of Immanuel Kant, who lived approximately 150 years after the discovery was made.

The quantum theory was born at the beginning of the present century, but it has not yet been philosophically evaluated. After nearly 50 years, the significance of this scientific discovery seems to be as uncertain as ever.

But now consider the Obvious movement. Gunpowder was discovered in the 12th Century, but two centuries elapsed before its technical development made it useful in warfare. Fission, on the other hand, was observed for the first time in 1939, and the first atomic bomb exploded in 1944. Five years saw the conversion of this scientific discovery into the deadliest of weapons. It is hard to find a more eloquent commentary on the acceleration which has taken place in the Obvious movement during our time.

The true meaning of science is seen as much in a study of the Obscure movement as in the technological results. Yet, because the public has had its eyes fastened on such tangible fruits of science as automobiles and television, its cultural and humanistic features have dropped from the popular view and a cleavage between the sciences and the humanities is claimed to exist. Hence it is well for us to look at science without the usual preconceptions.

In 1950 Anthony Standen wrote a book called *Science Is A Sacred Cow*. The title is the best part of the book, which represents a confused but entertaining account of the popular view with respect to the meaning and method of science, which, stated simply, is that facts are sacred and facts make science. Hence, science is no more than an encyclopedia of facts.

This view springs from the conviction that the greatest accomplishment of science is *discovery*. Science discovers new elements, new substances, new species of plants and animals, new planets, new stars and new galaxies. The glamour which attaches to the scientific awards given for discoveries of new elements or elementary particles has aided and abetted the belief that the only function of science is to turn up rocks and see what is under them.

Such factual search seems to exhaust the meaning of science in the public mind. Discoverable facts are regarded as interesting in themselves, no matter how trivial they are. Thus, when we read how an ancient tribe that never got anywhere and is now extinct, raised its cattle or educated its young, we are supposed to be tremendously impressed; a study of the Kinsey report on the sexual habits of unspecified human males and females is supposed to leave us speechless; and the headline which I recently saw: "Scientists Discover that the Reading of Crime Stories by Teenagers Contributes to Delinquency," is taken as offering a final solution to a vexing problem. According to this understanding, science is an aggregate of facts, often of trivia, to be reverenced just because they are factual.

This interpretation, unfortunately, extends beyond the popular mind to some scholars in the humanities who, regarding emphasis on facts as the sole characteristic of science, endeavor to convert their own disciplines into branches of science by advocating a restriction to facts.

Such was, for example, the attitude of the great 19th century historian Ranke, when he claimed that historical research must limit itself to factual reporting, to the testimony of eye witness; that theories and interpretations falsify and adulterate history. In contrast, the contemporary Toynbee avows a *theory* of history and believes, rightly or wrongly, that historical studies reveal a lawful trend in human development much as science uncovers the laws of nature.

Science is not a catalog of facts, but a human enterprise, propelled by a dream and a hope that transcends mere facts. Observations and measurements are needed, but not for their own sake. Mere facts are not the end of the quest; they are sought to illuminate *principles* that satisfy man's eternal longing for understanding in a sense beyond knowledge. Understanding differs from knowledge in this respect: it adds organization to knowledge, and organization is a creative act. Thus the accent of science shifts from discovery to creation, from the passive search for facts to an active drive for meaning.

The mood of old style science is caught up in the word: *evolution*. The future, as it were, twists itself out of the past, implying a measure of predetermination and fatalism.

The process of becoming can be described equally well in another way, by a change of view which turns from the past to the future. *Adventure* describes the mood of modern science.

II

HOW can we aid in narrowing the cultural lag and in easing the predicament of our time? I regard two propositions as among the most important answers to this question. The first is an appraisal of the doctrine called Existentialism, which is making universal claims that I believe need to be discouraged, for the doctrine of Existentialism contains no elements that can be expected to relieve our crisis. The second answer arises from the reputed conflict between science and the humanities, and suggests that we must remove this cleavage which has no foundation in the

facts of the disciplines nor in their methodologies. I shall claim that science can deal with values, and that there is no reason for us to suppose the methods of science to be alien to human affairs.

It is necessary for us to think sanely about the philosophy of despair called Existentialism.

This philosophic doctrine has recently swept the globe. It is especially strong in nations which do not have the material means to practice scientific research, but it is beginning to color the religious thinking in our country as well.

The doctrine has many forms and is difficult to describe because of its disavowal of any traditional metaphysical creed. It is, in the first place, among artists, a working attitude, which passionately seeks to justify the sordid as well as the magnificent contingencies of existence; it includes Nietzsche's joy over the death of God and Tillich's quietly pious "courage to be." With Kierkegaard, it is the resolution, brought on by irritation at the static concepts of traditional philosophy, to progress from the habit of *understanding backwards* to one of *living forward.* In Malraux, the accent is on the absurdity of life and on the need to endow it with significance through adventure. The words of Sartre, "a widower of God" in his own testimony, express and portray the "nausea of existence." But whether they admit it or not, all these men stage a revolt against science; their philosophy is a response to science, albeit a negative one.

For Existentialism, when it speaks philosophically, declares war upon *"essences,"* saying that *existence* comes before *essence.* What it means is that the bare facts and immediacies of our experience take precedence over the regularities and constancies constructed or found by reason. The essences of Existentialism, when freed of poetic disdain, are the *constant entities* and the laws of science.

This rebellion against science which has taken the name Existentialism, is aided and abetted by two significant facts. First, modern science has become increasingly, and at times forbiddingly, abstract, so that the artist is repelled by it because, in plain truth, he cannot understand it. Hence, the existentialist now spurns the scientist because he uses an esoteric tongue called mathematics, which, in the eyes of some, stultifies and poisons being before it is apprehended.

The second fact giving strength to Existentialism is the chaos of modern history which belies reason, order and essence. Quiet desperation, probing the depths of human tragedy, contemplating death and coming up with the resolve *to be in the face of absurdity*—such is an understandable sequence of experiences in the modern world of politics, natural to those who have severed their bondage to science.

In my view, this attitude is not consistent with the core of Western religion. There are important theologians who endeavor to widen the gulf between science and religion by basing theological doctrine upon the negative existentialist reaction to science. Their reasoning runs as follows: Man's distinction lies in his supreme loneliness, in his being cast into the *abyss of an individual life.* Being lonely, man develops anxiety about his solitude and particularly his *death.* The fellowship of other men only accentuates his own feeling of loneliness because they present further spectacles of anxiety in individuation. Man thus turns his face upward to the eternal, seeking grace, then down again in an all-embracing gesture in which he now joins through God with his fellow men. No doubt, these are important thoughts, but they neglect the fact that in normal man, there is a joy of living, a delight in fellowship, and the anxiety over loneliness is overcome by admiration for the magnificent orderliness of the laws of nature.

Besides, these thoughts are quite un-Christian. For was not Jesus in the setting of his time truly a man of the world? Was He not intensely gregarious? Did He fear death? Indeed He gave His life for His fellows —not because of His loneliness, but because He felt one with them.

THERE are important parallels between science and religion which are obscured by this kind of existential reasoning, which, moreover, does nothing to meet the emergency which the lag between scientific discovery and its cultural assimilation has created.

It is asserted that science is inapplicable to problems involving life, particularly human life. What force is there in such arguments?

(a) There is a great difference in the complexity of phenomena or number of variables, in the realm of the non-living and of the living. If an astronomer observes a comet in the sky, he can measure with good accuracy its position and its velocity, and on the basis of these two quantities he is able to calculate and to predict the motion of the comet for hundreds of years to come. On the other hand, the course of no living process can be predicted on the basis of the measurement of two parameters only; the number of variables is far greater, possibly infinite, and the very nature of the variables themselves is not known.

(b) A similar difference exists with respect to the control of variables. In the case of a physical object like the comet, it is unlikely that motion will be disturbed by other bodies and therefore the variables are fairly well controlled. Life, however, cannot develop without exposure to numerous unpredictable influences which would change the variables governing its development, even if these variables were known.

The possibility of "idealization," in which the scientist indulges in order to make his situations tractable by analytic means, cannot be used in living situations. The law describing the relation between the pressure of a gas and its volume is in general very complex. It takes on simplicity only for the ideal gas, where the relation is known as Boyle's Law. This idealization, however, holds only if the volume of the

gas is made very large. Thus the scientist, confronted with a complex situation, is able to control conditions in a manner enabling him to reach a simple law, provided he can assume that the molecules in his volume are very sparse. One cannot rarify society and study its behavior under similarly idealized conditions.

(c) The effects of a measurement or an observation on a system described by physical science is usually quite insignificant, whereas an observation, an inquiry, performed on a living organism, a human being, or on society, may falsify completely what the measurement is meant to represent. A stone falls, a comet moves, whether it is being observed or not. But to obtain crucial knowledge concerning a living cell, one may be forced to destroy it; an inquiry concerning the characteristic traits of a personality may well interfere strongly with the structure of the personality itself. Psychiatrists, sociologists, and economists know well how this interplay between the act of eliciting knowledge and the subject to which the knowledge refers interferes with predictions. If an economist predicted that a certain stock would rise five points on a certain day, and if he were believed, the statement would certainly be false, because the rush of buying would force the price beyond the predicted level. Modern science has a name for this interplay between the knower and the known, which seems to be limited to the living world: it is called "feedback."

(d) Finally, there is the possibility of free decision, an active characteristic of many living organisms but one of which inanimate objects presumably are not capable. This, it is believed, is largely responsible for the intrinsic unpredictability of human development, making this domain closed to the methods of science.

It happens that all these arguments have been rendered false by recent developments in science.

As to Item (a), the complexity of living processes, we must concede that social phenomena exhibit an uncomfortably large number of variables. Nevertheless, I wonder whether the situation in the social sciences may not be an indication of their relative youth. Physics, too, had an excessive number of variables in its early days. In Aristotle's theory of the fall of bodies, the speed of the descending object was a function of the time of fall, the weight of the body and the nature of the falling substance. Nearly 2000 years later Galileo was able to recognize that one crucial variable, namely acceleration, when introduced into the analysis of motion, makes the laws of nature beautifully simple. With this shift of attention to the concept of acceleration, the fall of a body no longer depends on three variables but only on the time of fall. All sciences in their early descriptive stage present more variables than are later needed. As time goes on, they succeed in recognizing certain critical variables, in terms of which description takes on simplicity and ease. Who knows whether this may not happen some day in the social field?

Recent years have caused the physicist to wonder whether the complexity in his discipline is not comparable to that in the domain of life. The ever-increasing number of different, so-called elementary, particles, the mesons, the hyperons, the strange particles, has created temporary disappointment and confusion. Nonetheless, the physicist looks hopefully into the future, convinced that the methods of his science will restore simplicity and elegance as time goes on.

As to Item (b), which is the affirmation that natural science can control its variables, let us note that it loses its point when attention is given to astronomy, the oldest of all physical sciences. The astronomer cannot arrange the configuration of his stars at his pleasure; he has to be content with natural situations as they arise. Yet this circumstance has not prevented him from being the first successful exact scientist in history.

Several decades ago, the contention that natural science is free from disturbing interaction between the act of observation and the object of observation had its point. At that time it was thought that a physical measurement could be carried out in a sufficiently careful manner so that its object would not be disturbed in a manner unpredictable by the laws of nature. Heisenberg's uncertainty principle, however, has called attention to a great number of measurements which have a disturbing effect. In many physical observations on atomic particles, the predictions based upon observation have exactly the same sort of effect upon the particles as the stock market prediction has upon the price of the stock. Yet the occurrence of "feed back" in the field of science has not forced the theorist to surrender the scientific character of his description.

In Item (d), we noted the element of decision said to be present in living behavior, but not in inanimate processes. A moving particle, it is often claimed, has a path; an organism capable of decision has a history. This attitude is no longer correct. We have learned that an electron's motion cannot be predicted by the deterministic laws of classical mechanics. To state matters somewhat anthropomorphically, the electron manifests a demeanor which would be described by saying that "it makes decisions." No amount of observations performed upon a moving electron can possibly reveal to us precisely what the particle is going to do. Its behavior is as though it acted in a manner of its own choosing. For such reasons, it seems questionable whether the element of decision, or rather, the unpredictable behavior of constituents of a society, makes their description any more difficult than the uncertainty principle makes the description of electrons.

A careful survey of the field reveals no intrinsic obstacles in the way of applying scientific methods to animate behavior, nor indeed to any other field. There is nothing in the fundamental procedures of science which makes it alien *per se* to the qualities exhibited

in human relations. Yet there exists, for many of us, a kind of psychological barrier which prevents us from wishing to give science its fullest scope.

Do we not sometimes feel that measurement, observation, deliberate analysis are *degrading,* or somehow inappropriate to the realm of values and to human conduct?

A work of art appeals in its integrity; a flower loses its beauty upon dissection, a poem upon analysis. Objective measurements, deliberate analysis, quantification are said to violate the qualitative wholeness of artistic being.

It is difficult, nay impossible, to demonstrate why the scientific approach should be degrading, why it should despoil and violate its object. Vast evidence is now accumulating to show that this view is an unfortunate hangover from a pre-scientific age, a hoary ghost which still inhabits the studios of some artists and the ivory towers of some professors. Scientists have never suggested that a poem be dissected for the sake of dissection, nor that a painting be subjected to chemical analysis. They do hold, however, that the good and the beautiful, like the true, should be amenable to understanding, indeed probably to quantitative understanding, and that such understanding will enhance these qualities rather than destroy or violate them.

The scope of science is embrasive, perhaps all-embrasive. It is not limited to the discovery of static principles and laws, nor is it restricted to a special kind of factual domain. Its worth and its carrying power can perhaps be suggested in terms of what I would take to be the scientist's creed, which might run perhaps as follows:

The scientist believes that the search for truth is a never-ending quest; yet he pledges himself to seek it.

He will not recognize or accept any kind of truth that pretends to be absolute or ultimate. He will consider and weigh all claims as provisional conclusions. If examination shows them to be stop signs on the road to inquiry, he will ignore them; if they are sign posts, he will note them and move on.

He recognizes no subjects and no facts which are alleged to be forever closed to inquiry or understanding; for science, every mystery is but a challenge.

He believes that new principles of understanding are constantly created through the efforts of man, and that a philosophy which sees the answers to all questions already implied in what is now called science is presumptuous, and contrary to the spirit of science.

He is confident that scientific illumination can be made to penetrate not only the dealings of man with nature, but likewise, the dealings of man with man.

As there are scientific laws, so are there discoverable ideals for human conduct. A scientist respects these and endeavors to apply them to his life.

These considerations might be formulated as an admonition to any student:

"Only a fool looks for truth in a finite formula; only a knave would want to acquire it without toil and heartache. Final truth is tantamount to stagnant knowledge; there is no substitute for self-correcting, progressing, self-improving understanding. Dismiss your quest for truth in final formulation and embrace the greatest human virtue, called Eternal Search For Truth."

The Challenge of an Enigma

IN the June 1957 issue of the *American Scientist,* Armand J. Eardley of the University of Utah discusses "The Cause of Mountain Building—An Enigma," with special emphasis upon the knowledge that can be obtained from the study of volcanic arcs.

Professor Eardley begins by saying that although the internal architecture of mountains and the erosional processes that create their outer appearance are fairly well understood, the cause of the deformation of the earth's outer layers and consequent mountain building is still unknown, although many theories have been formulated.

In all the principal mountain systems of the earth, geologists have observed evidence of shortening of the crust. Sedimentary rocks deposited as horizontal layers have subsequently been compressed, and have been buckled. Molten rock (magma) has invaded the superficial layers of the earth in many shapes, times, places and in varying composition. What causes the compression, what causes the great intrusions, of which Eardley quotes many examples, from the Rockies to the Appalachians? Both the eastern and western margins of the North American continent show considerable crustal shortening and intrusive activity, but the interior of the continent is only mildly deformed.

The constitution of the earth's crust under the oceans has long been considered different from that under the continents. With the perfection of new geophysical techniques, such as seismic exploration and the study of earthquake waves, studies have been made of the layers of the earth's crust. An upper layer of loose sand, silt and clay has a maximum thickness of about 2000 feet. Below this is a layer of partially solidified sediments which attains great thickness at the shelf margin. This rests on the ancient crystalline basement (crust or sial) under the continents, 35 kilometers thick, and basalt under the oceans, 6 to 10 kilometers thick. The lower part of the crust has been considered of basaltic composition, and is referred to as the subcrust or sima. Below the crust is the mantle, which is believed to be uniform in chemical composition down to hundreds of kilometers. These main layers of the earth's crust display a considerable difference between the continents and the oceans. Eardley states that the continents may be thought of as great thin pancakes of lighter density and more siliceous rock floating in a sea of heavier and more mafic rock. It is the margins of these continents that have been deformed most, and more repeatedly.

An intriguing aspect of certain continental margins is the volcanic island arc and associated deep trench in the ocean floor. One of these in the Pacific extends from the Aleutians all the way to the Banda Sea of the Dutch East Indies. The trenches are the deepest parts of the ocean floor and some exceed in depth the highest mountain peaks in elevation. The islands of these arcs are mostly active volcanic cones. The Lesser Antilles or Caribees form another arc of volcanic islands with a parallel deep trench. After Meinesz, the Dutch geophysicist, perfected an apparatus by which gravity could be measured, it was found that gravity over the trench was unusually weak. In order to account for a belt of low gravity, lightweight rock must displace heavy rock on a large scale. Meinesz concluded that the crust was down buckled into the heavier material of the mantle, which produced the negative gravity and also the trench. It is postulated that such a great down fold goes through several stages of compression and convulsion which result in the upthrust of mountain systems.

These volcanic island arcs and trenches are also regions of marked seismicity. The surface or zone from which earthquakes originate is regarded by Benioff as a tremendous fracture in the mantle along which small, sharp movement occurs intermittently.

Until the last thirty-five years, the belts of compression had been ascribed to shrinkage of the earth's interior with the resultant wrinkling of the crust. However, two factors challenge this concept: first, any logical amount of shrinking is too small to account for the crustal shortening, and second, the belts of great compressional deformation were created in short episodes and were not zones of continous uptake as would be necessary with a continuously shrinking interior.

The strength of the earth's crust is pertinent to the foregoing. Where large ice caps one to two miles thick have accumulated in the past, the surface has been depressed and, with the melting of the ice, has responded by uplift. Where mountainous areas have been eroded away and weight removed, the crust has been uplifted. The crust is in fact rather delicately balanced and adjusted to load, as a ship floating in water. The subcrustal material must be sufficiently viscous to flow and make adjustments. If the crust is in perfect floating (isostatic) balance, gravity should be normal, but if gravity is considerably more or less than it should be, then crustal forces are active and throwing the anomalous areas out of balance.

After a comprehensive review of the various hypotheses which have been advanced to account for mountain building, Eardley concludes: "In the study of mountain building geologists and geophysicists are far from agreed on the causes of, or mechanisms responsible for, crustal deformation . . . mountain building is still a fascinating riddle."

—*E. B. Sellon*

What Is Normality?

THE practice of focussing on the purely pathological in clinical studies of personality, and in the behavioral sciences generally, is criticized by Edward Joseph Shoben, Jr. of Teachers College, Columbia University. Writing in the April 1957 issue of *The American Psychologist* under the title "Toward a Concept of the Normal Personality," he points out that there is an impressive amount of empirical knowledge and theory about the diseased personality, but very little about the nature of psychological normality. The result of this imbalance has been that people are simply distributed along a dimension of pathology, in which some men are just a little queerer than others. Concepts of normality are based on a statistic of the usual or the average, and upon the notion of cultural relativism, or the degree of conformity to group norms.

Shoben feels that this statistical and relativistic point of view ignores the positive aspects of human personality which are of great importance in the socialization process and in psychotherapy. The main agents of socialization, such as the family, the church and the school, exist to facilitate positive growth of those characteristics which permit more productive and satisfying ways of life, and not just to minimize the development of pathological traits. This point of view is emerging in the field of public mental health, where there is a growing tendency to emphasize positive development, with the prevention and treatment of pathology regarded as vital but second.

The effort to discover in what positive development consists is not greatly helped by the statistical concept of the average, in which emphasis on "the usual" as the criterion of normality shades into a socially relativistic concept with an implied criterion of conformity to some group. Conformity is a dubious guide to conduct, for it frequently means acquiescence in conditions undermining the positive development of human beings. Moreover, there is the question of the reference group against which an individual is to be assessed, for what is abnormal behavior in one culture is frequently quite acceptable in another.

Shoben cites Wegnocki's criticism of such relativistic notions, in which he argues that it is not the form of behavior which defines its normal or pathological character, but rather its function. Abnormality lies in the effort to escape from conflicts and problems rather than to face them. But, Shoben says, what is involved in "facing" a problem? To deal with such questions requires coming to grips with certain problems of value. A primary challenge is that of providing a rational and naturalistic basis for a concept of integrative adjustment that is at once consistent with empirical science and in harmony with whatever wisdom mankind has accumulated.

To meet this challenge Shoben postulates a basic principle of value: behavior is "positive" or "integrative" to the extent that it reflects the unique attributes of the "human animal." Such a postulate is consistent with the implications of organic evolution, yet recognizes that man, while certainly an animal, can hardly be described as "nothing but" an animal. "His normality or integration seems much more likely to consist in the fulfillment of his unique potentialities than in the development of those he shares with infrahuman organisms."

Foremost among man's unique potentialites is his capacity for symbolization, which results in his use of propositional language. Propositional speech makes man the only creature who can learn not only from his own experience but also from that of other men in other times and places, forecast the consequences of his own behavior, and have ideals.

A second set of distinctly human potentialities is related to the long period of helpless dependence in infancy and childhood. This exposes youngsters to two fundamental conditions of human life: first, reliance on other people for one's own needs, and second, responsibility as an adult for mediating the needs of others. This relationship between reliance and responsibility obtains on adult levels as well, and gives human life a social character to be found nowhere else.

The symbolic capacity that endows man with foresight enables him to control his own behavior by anticipating its long-range consequences. The normal person acquires ability to control impulses through the symbolic cues he presents to himself in estimating the consequences of his behavior, thus drawing them into the psychological present. This increase in self-control means a lessened need for control by external authority, and conformity becomes relatively unimportant. The integratively adjusted person either accepts group standards or rebels against them, but both actions are taken on *considered* grounds.

A third characteristic of interpersonal responsibility deduced from man's social nature is dependability in relation to others, and at the same time acknowledgement of need for others. The integratively adjusted person is altruistic in that he acts out of a genuine concern for the welfare of others. Similarly, acknowledgement of one's need for others implies a learned capacity for forming and maintaining intimate interpersonal relationships: the attitude of "basic trust," or the ability to love.

Further, each individual, even if he regards himself as unfortunate and unhappy, owes his essential humanity to the group. A kind of obligation is therefore created for the person to be an asset rather than a burden to society. Because of man's social interdependency, which transcends provincial limits of group and era, the positively developed man behaves in such a fashion as to contribute to the general welfare of humanity. Therefore democratic social interest means the most direct route to the fulfillment of distinctively human capacity.

Finally, the normal person has ideals and standards that he tries to live up to even though they often exceed his grasp. Integrative adjustment does not con-

sist in the attainment of perfection, but in striving to act in accordance with the best principles of conduct one can conceive.

This model of integrative adjustment as characterized by self-control, personal responsibility, social responsibility, democratic social interest, and ideals, must be regarded only in the most tentative fashion, concludes Shoben, yet it takes into account some realistic considerations. It avoids the impossible conception of the normal person as always happy and free from conflicts. He may sometimes behave in ways that prove to be shortsighted or self-defeating, and he can hardly be entirely free from fear and worry.

On the other hand, such a person is likely to be one who enjoys a relatively consistent and high degree of self-respect and who elicits a predominantly positive and warm reaction from others. Moreover, such a person seems to learn wisdom rather than hostile bitterness or pathologically frightened withdrawal from whatever disappointments or suffering may be his lot. Guilt becomes a challenge to his honesty, and signalizes for him the desirability of modifying his behavior, or greater effort to live up to his ideals, rather than the need to defend himself.

Finally, such a model indicates that integrative adjustment does not consist in the individual's fitting a pre-conceived behavioral mold, but rather in the degree to which his efforts fulfill the symbolic and social potentialities that are distinctively human.

—*S. J. Nicholson*

NEWS AND NOTES

THE idea that the crust of the earth may have at least one layer which, like the shells of an ivory China-carved ball (but in this case deformable), can be worked independently of the rest of the mass may be difficult to take in. But this is precisely what is implied in the material presented on page 3 by Charles Hapgood. The full statement of the case will be available in 1958 in book form, and will then be analytically reviewed in these pages.

The summary here offered examines at such length as our space affords the still current hypothesis (Wegener's idea of continental drift), which claims to explain tropical fossil remains in what are now Arctic regions, so that that one contender may be dismissed by the reader fairly, on the basis of reasons put before him. We are then offered the data for a new explanation, namely, heavy off-centered Arctic ice accumulation which forced such a shift of the crust as to move the pole from its then location in what is now Eastern Canada to its present position.

Implied in the established fact that tropical conditions existed formerly in what are now very cold regions is *inter alia* the possible wholesale reorganization of our present views about the origin and age of man through discoveries of remains of vast antiquity, once we begin to look for them, because we begin to see that contemporary opinions are based on good enough factual evidence, but framed in a wholly misleading general theory about the history of the globe. Thus considered, *Displacement of Earth's Crust* is a kind of portent, and also a call for over-all studies of the structure of the earth. Is it not odd that we spend much money and time on studies of distant galaxies, and very little on systematization and enlargement of knowledge about our home planet?

In MAIN CURRENTS for October 1946 a modest attempt was made to discuss the earth as a well-ordered, significant (not accidental) system under which seem to lie forces and structures which are not fully disguised by the superficial irregularities. The patent fact is that there is a water and an earth hemisphere. Again, Gaylord Johnson popularized in 1936

a suggestion made earlier by Lothian Green that there is a basic tetrahedral earth-figure. Scattered in *Scientific American* (e.g., April 1928, page 309), in *Nature* (cf. December 24, 1932, page 973), and elsewhere in general scientific literature there is—and in specialist treatises there must be—much evidence for confidence in a great orchestration of systematic forces in the earth. Nowhere to our knowledge is all this assembled so that we can get at open questions such as the possible relation of the gravitational field to that of the magnetic field of the earth. Perhaps from the International Geophysical Year a permanent institution may arise, for such study. We might remark, in passing, that if any reader wants to hear the earth groaning in travail and crying out eerily in her electromagnetic tremblings, let him listen to the recording published in the series "Sounds of Our Times," by Cook Laboratories, Stamford, Connecticut, called *Out of This World*. On one side is "Earthquakes Round the World," and on the other "Ionospheric Swishes, Whistlers, Tweeks; the Dawn Chorus."

Mr. Hapgood's text, then, in addition to the interest in the content and the racing style in which it is written, may serve to remind us sharply that we know and care all too little about the vast-scale ecological principles which must be at work on and in the earth, and that the neglect of these is just a part of the deplorable failure to undertake systematizing and integrative research into principles of natural order, as a preliminary to improvements in education in the philosophy of science, and also specific studies of all kinds that would be prompted thereby. Millions are spent on collecting superficial behavioral data, and speculative opinions. Such outlays serve all too often mainly to crystallize our ignorance about nature and man, and the universe they express. Thus the school and college system grows more and more confused about essentials, and ever more rested upon untenable generalizations. Is it not high time that a center be developed where we can have accessible all the principles known about our earth, ourselves, and our place in the scheme? In this field Natural History museums function as encyclopedias do in the domain of books. Something much more philosophically independent and rich is called for.

—F.L.K.

THE Foundation for Integrated Education, in cooperation with the New School for Social Research, is offering a new series of eight lectures and discussions by Henry Margenau, Higgins Professor of Natural Philosophy and Physics at Yale University, under the general title, "The Realm of the Atom."

The series, which is a continuation of the lectures which Professor Margenau gave at the New School in 1956-57, will discuss the many fascinating new aspects of knowledge which are revealed through the principles of modern physics. The implications of this new knowledge, which has outmoded materialism and mechanism as philosophies of science, are highly significant, and should be understood by every thoughtful person.

The course of eight lectures will be held on Tuesday evenings, from 6:20 to 8 p.m., one in each month from October through May. The sequence of subjects is as follows: Development of the Atomic Concept; Atoms, Ether, and Light Waves; Probability and Indeterminacy; The New Causality and the Old Freedom; The Problem of Organization and the Principle of Exclusion; Relativity in Physics and in Ethics; The Idea of Fields in Physics and Biology; Reflections upon the Theory of Knowledge.

Registration may be made at the New School, 66 West 12th Street, New York 11, New York, at any time up to and including the date of the first lecture, October 15th. Attendance at single lectures is permitted.

THE Research Society for Creative Altruism, founded by Pitirim A. Sorokin, will hold its first public meeting, a conference on "New Knowledge in Human Values," on October 4th and 5th at Kresge Auditorium, Massachusetts Institute of Technology, Cambridge. The preliminary announcement of the conference lists as speakers: Gordon W. Allport, Ludwig von Bertalanffy, Theodosius Dobzhansky, Robert S. Hartman, Gyorgy Kepes, Lawrence S. Kubie, Dorothy Lee, Henry Margenau, A. H. Maslow, Pitirim A. Sorokin, Paul J. Tillich and Walter Weisskopf. It is not yet certain whether Jacob Bronowski and Erich Fromm will also be on hand. The aim of the conference is to report to the public on work in the broad field of human values (moral, spiritual, aesthetic, economic) and their application to the affairs and institutions of mankind.

THE Foreign Policy Research Institute of the University of Pennsylvania announces the publication of *Orbis*, a new quarterly journal of world affairs published by the Institute. The purpose of the journal is to offer insight and dispassionate analysis of the growing complexity of international affairs, upon which effective national policy must be founded.

The first issue of *Orbis*, Summer 1957, contains articles by Alvin J. Cottrell and James E. Dougherty, Gerhart Niemeyer, Walter F. Hahn, Norman D. Palmer and Roy F. Nichols. Subscriptions are $5.00 a year, and should be addressed to the University of Pennsylvania Press, 3436 Walnut Street, Philadelphia 4, Pa.

REVIEWS

Perspective on Astronomy

THIS admirable book must surely be unique: *Discovery of the Universe, Gérard de Vaucouleurs* (Macmillan, 1957, $6, 308 pages, illustrated, indexes and bibliography). For the philosopher of science whose field is not astronomy it is a long-awaited treasure. The author avoids irrelevant biographical details, but identifies and dates the contributions and lives of the great astronomers; he puts the serious lay reader in possession of major conceptual and factual developments without employing that insipid dilution called "popularization"; he provides superb photographs of most of the major celestial phenomena and gives a detailed text in each case, so that each can be placed meaningfully in the stellar system; he affords enough history of the science to provide perspective, but neither cumbers his pages with the errors of the ancients, nor does he bulk up the book with dramatized extended accounts of their discoveries, for which encyclopedias are available.

In our view only two notable defects occur in an otherwise superb, searching, complete yet compact treatise. First, the reader is not explicitly reminded that often in antiquity there was danger in challenging the official beliefs, *just because* among the tyrants muddled mythology was considered good philosophy of science and at the same time established religion. This ever-present risk is implied by remarks on page 23, as to ancient Greece, but not clearly stated. Yet that is why astute and original minds, such as Plato's, wisely taught their key doctrines orally, writing down only those parts that were likely to be politically inoffensive. The defective interpretations of Aristotle and Eudoxus could be, and were, safely circulated. The heliocentric system of Aristarchus of Samos and other solid studies of the Greeks were discredited publicly, to be sure, but formed part of the private communication among great men. Now and then—as in Euclid—their true views and real achievements are come upon by us. Our second criticism is that the author makes no reference to the astronomy of India, originally borrowed and then spread by Arabs. This omission will doubtless be corrected in a subsequent edition.

Subsequent editions are as certain as anything human can be in these turbulent times. The author, now on the staff of Lowell Observatory, Flagstaff, Arizona, has built up in a volume of modest thickness what comes out as a veritable reference book for the student of modern astronomy who is a little overfed by the speculative cosmologies of many writers, and who wants instead the solid data so that he can have the material with which to do his own thinking, first-hand. He may be confident that everything he is likely to need as to facts, methods, and significances has been marshalled and stated with that economy expected from those who know what they are about, and have the added advantage of formulating their thought originally in French, that language hardly equalled for lucidity. The translation seems to be the author's own work, aided in few chapters by Dr. B. Pagel.

—*F. L. Kunz*

Science As a Human Mode

SIX Wings, Men of Science in the Renaissance, by George Sarton (Bloomington, Ind., Indiana University Press, 1957, 233 pp., notes, index, $6.75) is the last book written by this great historian of science.

The book is based upon Dr. Sarton's Patten Lectures at Indiana University in 1954-55. The rather strange title of the book is ". . . a reference to the famous astronomical tables compiled by Tarascon (Bouches-du-Rhone) in 1340-65, and beyond them to the seraphim 'each of whom had six wings; with twain he covered his face and with twain he covered his feet, and with twain he did fly.'"

Increasing numbers of teachers are in search of supplementary materials with which to vitalize their subjects and to make them more humanly real. More and more teachers, both in fields of science and in the humanities, are requiring material with which to assist the student to perceive science as a human mode of approaching reality, or to make history come to life as something more than a chronology of political and military blunders. Both groups of teachers will find much assistance in these pages. What is more, here is demonstrated the oft-neglected fact that "truth," or "fact," or "natural law," is discovered quite as often by the cumulative plodding work of many as by the flashes of insight achieved by the few—this is something which needs to be stressed in education.

The "First Wing" establishes "The Frame of the Renaissance" with a consideration of its basic motivations: "Exploration and Education."

The "Second Wing" discusses "Mathematics and Astronomy" and brings into focus the personalities of many who are generally ignored by histories of science, much less by general histories.

The "Third Wing" does the same for "Physics, Chemistry and Technology" as do the "Fourth" and "Fifth Wings" for "Natural History" and "Anatomy and Medicine" respectively.

For integrating the material commonly discussed under "The Renaissance" with the urgency to bring science to the non-scientist and the humanities to the science student, these chapters are rich sources of material.

The "Sixth Wing" is devoted to "Leonardo da Vinci: Art and Science." A few excerpts from this chapter will serve as samples of Sarton's style and his great humanity: "We should not forget that he [Leonardo] lived in an age that was as revolutionary as ours but far more cruel. It was the age of despotic rulers like Lodovico Sforza and Cesare Borgia (the 'Prince' of Machiavelli) and of violent enthusiasts, like Savonarola. Leonardo preserved his equanimity and his wisdom. He was an artist, a poet, a contemplator, a dreamer. On account of such 'weaknesses' he became greater, closer to per-

fection, than if he had been more capable and 'efficient.' If a man is good and wise, why should he be efficient into the bargain? . . .

"Durer was a businessman, a man of substance living in his own comfortable house, he was capable of taking some interest in scientific questions, but he was not a man of science. Leonardo, on the contrary, was a pure artist, a disinterested inventor, a man of science, a cogiator, a Bohemian; he was decidedly not a businessman or an administrator. He was anxious to obtain not money, or power, or comfort, but beauty and truth. He wanted to understand God, nature, art, himself, and other men. I admire them both, but I love Leonardo."

—Harvey W. Culp

A Study of Creativity

WITH the renewed awareness of the close relationship between basic human functioning and educational methods, and with the redefinition of "culture" in a broader sense, it is interesting that art has gained new status in elementary and secondary education. It is no longer either a pre-vocational major for the few or elementary grade "prettifying" busywork. We have come to evaluate art in a much more valid sense.

With the publication of the third edition of *Creative and Mental Growth* by Viktor Lowenfeld (New York, The Macmillan Company, 1957, 508 pp. bibliography, index, $5.90), not only art teachers but *all* teachers can be better equipped to approach art and creativity with greater understanding and effectiveness.

This excellent book, liberally illustrated, is (in the opinion of this reviewer) a solid piece of work which relates creativity to mental processes without inducing an excessively clinical approach. Too often, we believe, teachers have fallen into the current trap of attempting to be amateur psychoanalysts, and projecting far too much into the creative works of children. In moderation, this can be done wisely and successfully. However, there is vastly more that can be understood about a child if we view his creative works as projections of reality as he perceives it.

Today, views of man give far greater weight to his creativity than those of only a few years ago. We have learned to stand with reverence and humility before the fact that each of us lives in a private perceptual cosmos of our own creation. So the teacher who better understands his pupils, because of his awareness that creativity, mental growth, and reality as it exists for each of his pupils are inextricably inter-related, is in a much better position to teach *anything*.

In this edition, the author has paid special attention to creative activity in its relation to the crises of adolescence. Here the book may have special value for those who would try to find means of orienting youth to our modern age and its problems through creation rather than "recreation."

The book is also valuable in explaining differences in persons and their creative productions in the light of modern electro-encephalographic types and other recent advances in psychology.

We recommend this book warmly.

—Harvey W. Culp

Causality and Synchronicity

THE *Interpretation of Nature and the Psyche* (Pantheon Books, Bollingen Series LI, 1955, $3.00, 240 pages, index) consists of two essays: "Synchronicity, an Acausal Connecting Principle," by the psychologist C. G. Jung, and "The Influence of Archetypal Ideas on the Scientific Theories of Kepler," by the physicist, W. Pauli. These essays were originally published in German in 1952, at which time they were reviewed in MAIN CURRENTS (Vol. 10, No. 5, pp. 114-115), but it is felt that the importance of their concepts warrants this present review of the English edition, which has since become available.

The end result of this collaboration between a physicist and a psychologist is a scheme (on page 137) in which the authors set *indestructable energy* (the Vedantin *mula-prakriti*) opposite to the *space-time continuum,* and *constant connection through effect* (*causality resting on probability*) opposite *inconstant connection through contingency, equivalence.* To this latter *meaningful coincidence in events* (*not causally*) Jung gives the name of synchronicity. In the latter part of his essay, he broadens the definition of synchronicity into "acausal orderedness." His use of the term, "causality," seems to limit it to connections in the normal flow of time and space.

The meaning of synchronicity is only slowly grasped. The reason for this, as Jung points out, is that our Western culture has, during the course of the eighteenth and nineteenth centuries, swung almost completely away from any other explanation of events than that of causality and chance:

"The primitive as well as the classical and medieval views of nature postulate the existence of some such principle alongside causality. Even in Leibnitz, causality is neither the only view nor the predominant one. Then, in the course of the eighteenth century, it became the exclusive principle of natural science. With the rise of the physical sciences in the nineteenth century the correspondence theory vanished completely from the surface, and the magical world of earlier ages seemed to have disappeared once and for all until, towards the end of the century, the founders of the Society for Psychical Research indirectly opened up the whole question again through their investigation of telepathic phenomena . . .

"The idea of synchronicity and of a self-subsistent meaning, which forms the basis of classical Chinese thinking and of the naive views of the Middle Ages, seems to us an archaic assumption that ought at all costs to be avoided. Though the West has done everything possible to discard this antiquated hypothesis, it has not quite succeeded. Certain mantic procedures seem to have died out, but astrology, which in our own day has attained an eminence never known before, remains very much alive. Nor has the determinism of a scientific epoch been able to extinguish altogether the persuasive power of the synchronicity principle. For in the last resort it is not so much a question of superstition as of a truth which remained hidden for so long only because it had less to do with the physical side of events than with their psychic aspects. It was modern psychology and parapsychology which proved that causality does not explain a certain class of events and that in this case we have to consider a formal factor, namely synchronicity, as a principle of explanation."

A chapter in the essay is devoted to an attempt to

validate certain astrological postulates. The results are confusing statistically, but in the process of the experiment some interesting things were learned about meaningful arrangements of data and their connection with unconscious tendencies to structure them in certain ways.

The contrast which Jung postulates between the causality principle and the hynchronistic principle is put succinctly in the following passage.

"The causality principle asserts that the connection between cause and effect is a necessary one. The synchronicity principle asserts that the terms of a meaningful coincidence are connected by *simultaneity* and *meaning*. So if we assume that the ESP experiments and numerous other observations are established facts, we must conclude that besides the connection between cause and effect there is another factor in nature which expresses itself in the arrangement of events and appears to us as meaning. Although meaning is an anthropomorphic intepretation, it nevertheless forms the indispensable criterion of synchronicity. What that factor which appears to us as "meaning" may be in itself we have no possibility of knowing. As an hypothesis, however, it is not quite so impossible as may appear at first sight. We must remember that the rationalistic attitude of the West is not the only possible one and is not all-embracing, but is in many ways a prejudice and a bias that ought perhaps to be corrected. The very much older civilization of the Chinese has always thought differently from us in this respect, and we have to go back to Heraclitus if we want to find something similar in our civilization, at least where philosophy is concerned . . ."

The tremendous importance of this book lies in the fact that it is, to the knowledge of this reviewer, the clearest beginning so far made to a theoretical structure which will underlie many of the puzzling phenomena which have been popping up in a variety of fields—in physics, for instance, the connection of time and space, and the principle of discontinuity (e.g., the orderedness of energy quanta, of radium decay, etc.); in biology, some aspects of morphology; in psychology, certain questions raised by Gestalt psychology, how parapsychology works, and (in the analytical field) certain connections between psychic events, such as dreams, and physical events or other psychic events. Our present Western culture has clung to the absolute supremacy of the causality principle as to a god, and this allegiance does not die easily. However there are signs on all sides that some of the old gods are about to tumble, and we are on the verge of a breakthrough to a widening of understanding and a blossoming forth of a new type of knowledge in the same manner that our scientific knowledge blossomed in recent centuries. As in all such developments, the next step is a carefully elaborated theory which will support the empirical data which our established theoretical structures have not been able to accommodate. Then our collective Western psyche may be able to release its hold on the powerful but lesser god of time-bound cause and effect and embrace a greater being who incorporates the magical meaningfulness of the unexpected as well as the security of the causally meaningful.

—Marifrances Orser

THE importance of the essay, "The Influence of Archetypal Ideas on the Scientific Theories of Kepler," lies in the fact that it was written by one of the most outstanding present-day theoretical physicists, W. Pauli. He is a Nobel Prize winner and discoverer of the Exclusion Principle. Pauli in collaboration with Niels Bohr had much to do with the development of quantum physics.

Johannes Kepler (1571-1630), besides being an astronomer, practiced astrology. One may almost say that his astronomical work was a by-product. He discovered the three laws of planetary motion. Though a contemporary of Galileo, it can be said that he belonged still in the prescientific age with his ideas on the order of the cosmos. He believed that the Universe was subject to a higher objective order which cannot be discovered by pure empiricism and logic. He believed that the knowledge of the nature of things can be arrived at by directed attention. He was of the opinion that the human soul has knowledge a priori and that human happiness is derived from confirming it by perception. This knowledge a priori or primordial ideas are called *archetypes*.

Kepler stressed the quantitative phase of nature to the detriment of the qualitative conception. His nature was animated, as, for example, he believed that planets have souls similar to human ones. He conceived the human soul as a perfect circle which reacted with the planetary souls according to quantitative laws rather than according to qualitative ones (such as love and hate and so on). He published his ideas in several volumes and this ran into a polemic with Fludd, who was an alchemist and Rosicrucian. Fludd believed in the intuitional conception of the cosmos and completely disregarded the quantitative side of nature.

W. Pauli says that both views were rejected by the later scientific age but that it is becoming more and more necessary now to examine both views without outright rejection of either one. The phenomena occurring in the study of microphysics cannot be explained by causality alone, but they must be treated on the basis of probability. In other words, the observer cannot arrive at the cause of effects. The observer influences the observed and vice versa he is profoundly influenced by the observed. From this arises the principle of indeterminancy.

W. Pauli believes that it may be highly beneficial for modern physics to return to the intuitional concepts of nature.

—Bohumir Larys

IN addition to the books reviewed above, the following have recently been received:

Life, Language, Law: Essays in honor of Arthur F. Bentley, ed. by Richard W. Taylor (The Antioch Press, Yellow Springs, Ohio, 1957, 233 pp, bibliography, index, $4.50).

Occupational Information, Where to get it and how to use it in counseling and teaching, by Robert Hoppock (McGraw-Hill, 1957, 534 pp, bibliography, index, $6.75).

The Tao of Painting, by Mai-Mai Sze (Bollingen Series XLIX, Pantheon Press, 1956. In two volumes: Vol. I, 161 pp; Vol. II, 587 pp; illus, bibliography, index, $25.00).

A Fourth of a Natiton, by Paul Woodring (McGraw-Hill, 1957, 255 pp, index, $4.50).